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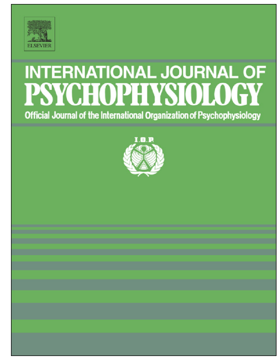

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The *Body-Threat Assessment Battery (BTAB)*: A New Instrument for the Quantification of Threat-Related Autonomic Affective Responses induced via Dynamic Movie Clips

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Abstract

We present a new instrument for the assessment of responses to threat-related imagery directed towards a human body – the *Body-Threat Assessment Battery* (BTAB). The BTAB consists of a series of high-definition dynamic clips depicting body-threats and matched non-threat baseline behaviours. For body-threat stimuli a perspective manipulation was included to assess the effects of viewing threats from the point-of-view of the observer (POV) or from an external / exocentric perspective (EXO). Green-screen technology was used so that extraneous background information could be removed and standardised in post-production. Categorical normative data for psychological ratings (valence, arousal and pain), psychophysiological, phasic skin conductance responses (SCRs) and tonic skin conductance levels (SCLs) were obtained for all stimuli. Body-threat stimuli evoked significantly higher psychological ratings of arousal and pain, with more negative ratings of valence, relative to baseline stimuli. In addition, threat stimuli also had an increased efficacy at evoking SCRs, and these were significantly stronger relative to baseline stimuli. There were no effects of perspective on psychophysiological or psychological responses to threat imagery. The findings are discussed in the context of the utility and scope of the BTAB for supporting neurocognitive investigations of aversive imagery and body-threats specifically in the study of embodiment, body-processing and self-consciousness.

Keywords: Body threat imagery; Self-consciousness; Body image; Autonomic responses; Skin conductance responses; Psychophysiology.

1.1 Introduction

Presenting stimuli on a computer screen and quantifying psychological, autonomic and / or neural responses has a long history in psychological science (Aaronson, Grupsmith, & Aaronson, 1976; Bradley, Codispoti, Cuthbert, & Lang, 2001; Bradley & Lang, 1994; Boucsein, 2012; Castellan, 1981, 1991; Dawson, Schell, & Filion, 2007; Ito & Cacioppo, 2000; Lang & Bradley, 2010; Lang, Bradley, & Cuthbert, 1997; Lang, Greenwald, Bradley, & Hamm, 1993; Miller, 2003; Sturm & Ash, 2005). The interpretation and processing of emotions and emotional stimuli is often considered in relation to two motivational systems, appetitive (to promote survival including nurture, caregiving and sustenance) and defensive (to avoid threat including escape, attack and withdrawal). That is, judgements about whether an image is pleasant or unpleasant (i.e. valence) can indicate which of the two systems is engaged, and judgements of arousal can indicate its intensity (Bradley et al., 2001; Lang et al., 1993; Lang & Bradley, 2010).

Typically, researchers have studied emotion regulation, valence and arousal via the presentation of emotionally arousing and negative stimuli. These approaches utilise a variety of stimulus modalities including pictures (e.g. the International Affective Picture System [IAPS]: Lang et al., 1997; Amrhein, Mühlberger, Pauli & Wiedemann, 2004; see also Bradley et al., 2001; Lang et al., 1993; Sierra et al., 2002;), static or dynamic facial expressions (e.g. Pictures of Facial Affect: Ekman and Friesen, 1976; Blair, Morris, Frith, Perrett, & Dolan, 1999; Breiter et al., 1996; Esteves, Dimberg & Öhman, 1994; Morris et al., 1998; Phillips et al., 1997, 1998; Weyers, Mühlberger, Hefele, & Pauli, 2006; Wieser, Pauli, Alpers, & Mühlberger, 2009), segments from movies (Arnaudova & Hagenaars, 2017; Carvalho, Leite, Galdo-Álvarez, & Gonçalves, 2012; Codispoti, Surcinelli & Baldaro, 2008; Droit-Volet, Fayolle, & Gil, 2011; Giesbrecht, Merckelbach, van Oorsouw, & Simeon, 2010; Hubert & de Jong-Meyer, 1990; Palomba, Sarlo, Angrilli, Mini & Stegagno, 2000; Rooney, Benson & Hennessy, 2012; Schaefer, Nils, Philippot, & Sanchez, 2010), the imagination of negative scenes or the recollection of past emotional life events, such as times of anxiety or anger (Lane, Reiman, Ahern, Schwartz & Davidson, 1997; Lane et al., 1998; Kimbrell et al., 1999).

One helpful resource used across a variety of studies is the IAPS (Lang et al., 1997), which consists of a large collection of images that depict negative, positive and neutral visual imagery. The processing of such stimuli are often coupled with an extensive array of psychological and psychophysiological measures including self-report ratings, EEG, facial EMG, autonomic arousal (electrodermal activity e.g. skin conductance responses: SCRs) and heart rate (Alpers, Adolph, & Pauli, 2011; Amrhein et al., 2004; Bradley et al., 2001; Hamm, Cuthbert, Globisch, & Vaitl, 1997; Lang et al., 1993, 1997; Lang & Bradley, 2010); Schupp, Junghöfer, Weike, & Hamm, 2003; Sierra et al., 2002; Wendt, Weike, Lotze, & Hamm, 2011).

A wealth of research using the IAPS has facilitated the exploration of emotional material by comparing pleasant versus unpleasant imagery, such as via negative scenes (including attacking animals, human attack and contamination) and facial expressions (Alpers et al., 2011; Bradley et al., 2001; Lang et al., 1993, 1997), or more specifically in relation to those with phobias, e.g. snakes or spiders (Hamm et al., 1997), for recollection of emotionally arousing imagery (Versace, Bradley & Lang, 2010) or within the context of competition for attentional load (Schupp et al., 2003). Findings from such studies have shown that IAPS pictures representing unpleasant emotional content (i.e. animal or human attack) elicit larger SCRs, evoke a greater startle reflex and acquire greater attentional load compared to more pleasant / neutral images (Bradley et al., 2001, Lang et al., 1993; Schupp et al., 2003). These findings have been taken as evidence for the motivational hypothesis of emotion; that affective responses serve different functions, and when pictures represent threats to life (e.g., attack) they engage and reflect distinct primary motivational states that facilitate adaptive behaviour for evolutionary survival (Bradley et al., 2001; Lang et al., 1993; Schupp et al., 2003).

Brain imaging (e.g., fMRI/PET) studies using the IAPS have also revealed distinct neural responses when people view negative versus neutral or positive imagery. For example, relative to positive images, negative stimuli from the IAPS and negative facial expressions (e.g. sad, angry or fearful) have been associated with increased neural activation in the amygdala and anterior cingulate cortex (Blair et al., 1999; Breiter et al., 1996; Hägele et al., 2016; Morris et al., 1998; Phillips et al., 1997, 1998). Similarly, Simmons, Matthews, Stein, and Paulus, (2004) used negative IAPS images (snakes and spiders) and found significant neural activation (insula, dorsolateral prefrontal cortex and parahippocampal gyrus) to the mere anticipation of observing negative / phobic stimuli.

However, while informative, there are a number of potential concerns with such stimulus modalities that raise some questions. For example, the recollection of past emotional life events is difficult to standardise across participants and risks additional confounding variables such as participant (e.g. demand characteristics) or memory bias (Lalande & Bonanno, 2011; Levine & Safer, 2002; Schacter, Chiao, & Mitchell, 2003). Despite the popularity of the IAPS, similar limitations might also apply to its use in contemporary investigations. Owing to the vast collection of images available, it is possible that there are inconsistencies during image selection or determining category “cut-off” points; where selection appears tailored for specific studies or researcher intuition, rather than being based on an established strategy (see Barke, Stahl, & Kröner-Herwig, 2012; Constantinescu, Wolters, Moore, & MacPherson, 2017).

To navigate many of these issues, and to add increased realism and ecological validity, Aluja et al., (2015) argued for the use of short, dynamic film clips instead of static images. However, movie film scenes have additional factors present that one cannot necessarily standardise or control, including; (i) background imagery and the likelihood that film clips typically contain multiple images in quick and variable succession, (ii) the presence of additional actors or characters, (iii) different camera angles e.g. framing, viewpoint or movement, (iv) sound, (e.g., film clips may also include auditory signals such as music or sound effects) and (v) there is often no consideration as to whether the participants have seen the film previously, which may influence the subjective and / or autonomic emotional response for that scene (see Carvalho et al., 2012; Schaefer et al., 2010 for similar discussions). This is particularly relevant for scenes with a long duration; Giesbrecht et al., (2010) for example, played a long clip (12:30 min) of a Hollywood film containing alternating scenes and multiple characters and sounds, and it was not clarified whether participants had seen the film previously. The presence of sound is equally important, given that the emotional experience of observing negative imagery is thought to be more profound when combined with auditory stimuli (Baumgartner, Esslen, & Jäncke, 2006; Ethofer et al., 2006; Kreifelts, Ethofer, Grodd, Erb, & Wildgruber, 2007; Stein, London, Wilkinson, & Price, 1996; Vroomen & De Gelder, 2000). Therefore, while such investigations are indeed helpful in the examination of autonomic processing and affective states, it is not always clear what the contributions are from these different factors.

Further methodological issues concerning stimuli such as those in the IAPS, have demonstrated reduced emotional potency, as indicated by reduced skin conductance responses (SCRs) and reduced neural (amygdala) activity, for negative IAPS images in comparison to other stimulus sets such as negative facial expression stimuli (Hariri, Tessitore, Mattay, Fera, & Weinberger, 2002). Likewise, in unpublished findings from our laboratory we have observed that the IAPS stimuli can lack sufficient potency for generating SCRs (low efficacy), and participants have frequently reported the stimuli as innocuous and outdated (the original IAPS was published in 1997). In addition, a host of participants have found some of the negative images to be highly amusing, even though they depict a negative image (i.e., a decapitated body). The explanations provided by participants have tended to reflect the very dated nature of the images and / or the attire worn by the persons depicted in them (i.e., 1970s flared trousers, certain hairstyles, etc.). This issue is important for the interpretation of evoked SCRs because such unintended effects of laughter or amusement for negative imagery can make the interpretation of SCRs ambiguous. Consequently, it may well be incorrect to infer that SCRs to this type of imagery necessarily reflect the processing of the "aversive" nature of the imagery.

Another methodological issue is that although previous studies may report the strength (magnitude[1]) of averaged SCRs to the stimuli presented, it is not always the case that data on the efficacy (i.e. frequency) of the chosen stimuli in successfully eliciting an SCR is presented (Armel & Ramachandran, 2003; Cuthbert et al., 2003; Drabant et al., 2011; Giesbrecht et al., 2010; Lemche et al., 2008). In other words, within a study, some stimuli may only elicit a few SCRs while other stimuli may elicit many – but if only the average strength of the stimulus response is reported, it can be difficult to determine how effective certain stimuli are at eliciting SCRs – with implications for the stability / reliability of any averaged measures.

1.1.1 Autonomic responding and anomalous bodily experience

Previous research has revealed atypical autonomic responses (e.g., SCRs and neural activity) to negative stimuli in patients with schizophrenia, anxiety / panic disorder, depersonalization disorder and non-clinical groups with a predisposition to depersonalization-type experiences (Aghevli, Blanchard, & Horan, 2003; Braithwaite, Broglia, & Watson, 2014; Dewe, Watson, Kessler, & Braithwaite, 2018; Dewe, Watson, & Braithwaite, 2016; Kohler, Bilker, Hagendoorn, Gur, & Gur, 2000; Medford et al., 2016; Monk et al., 2006; Nitschke et al., 2009; Shin et al., 2005; Sierra, Senior, Phillips, & David, 2006; Takahashi et al., 2004). Depersonalization disorder, for example, is often referred to as an "unreality" from the self (Sierra, 2009; Sierra & David, 2011). A core aspect of depersonalization is the presence of profound anomalous body experiences and a dissociation from the physical self /

[1] Note: the strength of an SCR can be referred to as *magnitude* or *amplitude*; where magnitude includes all stimulus-driven responses (i.e. includes zero responses to stimulus presentations) and amplitude includes only measurable (i.e. non-zero) responses. The strength of a SCR can be thus influenced by the frequency of responses elicited by stimulus presentations (Boucsein, 2012; Boucsein et al., 2012; Braithwaite, et al., 2013).

body. Patients display significantly reduced autonomic responding (e.g., supressed SCR strength) and reduced activity in the amygdala and anterior insula when observing negative imagery, such as facial expressions, emotional film clips and unpleasant images from the IAPS (Giesbrecht et al., 2010; Lemche et al., 2007, 2008; Phillips et al., 2001; Sierra et al., 2002; 2006; Sierra & David, 2011).

Despite anomalous body experiences being a core symptom of disorders like depersonalization, the stimuli used in many of these previous studies do not consist of body-specific imagery but of generally “aversive” content such as cockroaches, sharks and a used toilet (Sierra et al., 2002; 2006; Phillips et al., 2001). In addition, the symptoms often observed in depersonalization are thought to be mediated by inhibited activity / aberrant biases in processes underlying internal (interoceptive) bodily signals; and such processes are considered fundamental to subjective emotional experience and the generation of conscious feeling states (Craig, 2003; Seth, 2009; 2013; Seth, Suzuki, & Critchley, 2012; Suzuki, Garfinkel, Critchley, & Seth, 2013). These concerns emphasize the importance of using body-related imagery to provide a comprehensive investigation of aberrant biases in self-consciousness. However, due to the lack of a relevant stimulus set, there appears to be a paucity of research that determines the potential for biases in the processing of specific body-related information (and indeed, aversive body-threat information) in relation to anomalous body experiences and even more so for non-clinical populations displaying a predisposition to such experiences.

1.1.2 Rationale for the present study

Current approaches for quantifying cognitive and affective states through the presentation of visual stimuli often do not contain specifically constructed baseline imagery, do not use dynamic clips (and when they do it is often from Hollywood films that are not standardised with many factors free to vary) and do not consider aspects such as controlling for the viewing perspective. The *"Body-Threat Assessment Battery"* (BTAB) was developed to address the concerns outlined above and represents several new developments to facilitate a direct examination of bodily self-consciousness and the relationship between aberrant body experiences and aversive body-imagery.

The BTAB is comprised of high-definition dynamic movie clip stimuli of a diverse range of graphic (simulated) body-related threat behaviours (e.g. a knife cut to the wrist, a throat being slashed, a fingernail removed with pliers, etc) conducted directly on a human model. The BTAB also includes baseline clips depicting non-threatening behaviours (e.g. soft brush strokes to the forearm) and non-body-based actions (e.g. cuts to fruit or inanimate objects). Therefore, the baseline clips differed primarily in that there were no threats directed towards a human body – though most contained the use of a threatening object. The dynamic nature of movie clips over static images can increase the realism and ecological validity of the stimuli, and enable the investigation of simulated and potentially life-threatening body-based threats conducted on a human being.

The BTAB provides several advantages over pre-existing collections of negative imagery. These include; (i) all body-threat clips depict a "live" simulated threat behaviour towards a human body – thus creating a realistic and potent visual experience, (ii) potential emotional reactions perceived from the model's face were removed since all threats were delivered to the torso, arms or hands (thus removing the potential for the transmission of emotional / affective cues from the model / avatar), (iii) the contextual background was standardised via green-screen technology, reducing the role of non-standardised / extraneous visual cues on the visual processing of the clips, (iv) the task facilitated a direct comparison between body-based and non-body based (baseline) threatening actions, and (v) the battery includes a perspective manipulation in which threat presentations are delivered from a first-person, point-of-view (POV) perspective or from an exocentric (EXO) perspective.

The rationale for adding a perspective manipulation is based on the literature that human observers may spontaneously adopt or “mirror” another’s perspective in specific contexts (i.e., Samson, Apperly, Braithwaite, Andrews, & Bodley-Scott, 2010) which may further mediate autonomic and psychological responses. In addition, previous findings have provided evidence of shared neural activations and increased autonomic arousal for observing others in pain-related scenarios (Dewe et al., 2018; Jackson, Brunet, Meltzoff, & Decety, 2006; Jackson, Meltzoff, & Decety, 2005; Jackson, Rainville, & Decety, 2006), and the assumption that threats from a POV perspective may be more aversive as this may simulate, more readily, the idea that the threat is happening to the observer.

It is hypothesised that threat imagery will produce an elevated autonomic response in observers relative to baseline imagery and that this response may be further mediated by the perspective of the imagery. It was also hypothesised that psychological ratings of arousal and pain will be elevated for threat imagery and ratings of valence will be more negative for threat imagery relative to baseline imagery. The current study aimed to introduce the BTAB, to determine the range of psychological and physical normative categorical responses to each clip, and explore its utility for use in contemporary studies.

1.2 Method & Measures

1.2.1 Participants

Two-hundred participants were recruited from the School of Psychology, University of Birmingham and the Department of Psychology, Lancaster University. The sample comprised of 164 females (82%) and 36 males (18%) aged between 18 – 49 years ($\bar{X}$ = 21 years, σ = 5.42). Before participating in the study, all individuals completed a consent form and consulted an information pack, which sought to ascertain that they did not have any severe or debilitating phobia of threat-related imagery (e.g. needles or the sight of blood). There were no self-reports of any medical history of psychiatric or neurological disorders. This project complied with ethical practices and was approved at both institutions reference number ERN_15-0384 (University of Birmingham) and FST16039 (Lancaster University).

1.2.2 Electrodermal Activity (EDA)

Electrodermal activity (EDA) was used as an objective measure of autonomic arousal during the viewing of the BTAB. A constant weak voltage of 0.5V was applied. A high-pass filter of 0.05Hz was applied to all signals. In the present context, EDA was conceptualised as threat-related skin conductance responses (SCRs), additional Stimulus-Specific SCRs (SS-SCRs), and the tonic skin conductance level (SCL). All EDA data were recorded via an MP36R unit (Biopac systems Inc, Goleta, CA) connected to a HP pro Elitebook laptop, using SS57L leads and pre-gelled disposable Ag-AgCl electrodes (EL507) affixed to the distal phalanges (index and middle finger) of the left hand. Data were sampled at 2000 Hz. The threshold for skin conductance responses (SCRs) was set at 0.01 μS (microsiemens) from the background (tonic) signal and defined as the magnitude[2] (difference) between SCR onset (crossing the threshold) and the maximum peak value reached for that SCR (in μS). Threat-SCRs were quantified as the largest individual SCR that occurred during the movie clip (after an initial 1-second period after onset) and covering the remainder of each clip presentation. The largest SCR was taken as the threat SCR due to the nature of dynamic imagery (Boucsein, 2012; Dewe et al., 2016; 2018). Given that dynamic imagery is constantly

[2] We report all SCRs as magnitude values which includes all zero responses to the presentation of a stimulus (Boucsein, 2012; Boucsein et al., 2012; Braithwaite, et al., 2013).

changing, and the variable time-course of SCRs, it is not possible to determine the exact part of the clip that is responsible for eliciting a given SCR and perhaps the critical one representing cognitive-affective threat processing. To deal with these issues, we made the assumption that by always taking the largest response we were taking the strongest response from the system during that time period and in the context of aversive threatening imagery – this most likely will be tied to the cognitive and affective processing associated with the threat (see, Alpers, Adolph & Pauli, 2011; Amrhein et al., 2004; Armel & Ramachandran, 2003; Bradley et al., 2001; Boucsein, 2012; Detenber, Simons & Bennett, 1998; Dewe et al., 2016, 2018; Esteves et al., 1994; Esteves, Parra, Dimberg & Öhman, 1994; Hamm et al. 1997; Lang et al., 1993; Ocklenburg, Rüther, Peterburs, Pinnow & Güntürkün, 2011; Sierra et al., 2002; Sierra, Senior, Phillips & David, 2006; Simons, Detenber, Roedema & Reiss, 1999; Wieser et al., 2009 for similar approaches).

To complement the threat-related responses (threat-SCRs), we also examined both the frequency and magnitude of the remaining SCRs for each movie clip presentation (referred to here as Stimulus-Specific SCRs: SS-SCRs). These were quantified as the average frequency and magnitude of all remaining SCRs that occurred during each clip presentation that were not identified as the largest response (the threat-SCR), but reflected additional autonomic arousal elicited during the viewing of the continuous clip. These SS-SCRs occur over the duration of the imagery and previous research has demonstrated that the frequency and / or amplitude of such responses, that are often termed "non-specific", may in fact be influenced by negative conscious states such as anxiety / fear or represent anticipatory processes (Boucsein, 2012; Braithwaite et al., 2014; Dewe et al., 2016; 2018, Nikula, 1991). To facilitate individual differences and parametric analyses the magnitudes of all SCRs (threat-SCRs and SS-SCRs) were normalised using (Log (SCR +1) transformations and standardised via Z-score transformations for each participant following EDA analysis recommendations

(Ben-Shakhar, 1985; 1987; Boucsein, 2012; Boucsein et al., 2012; Braithwaite, Watson & Dewe, 2017; Braithwaite, Watson, Jones, & Rowe, 2013; Bush, Hess, & Wolford, 1993; Dawson et al., 2007).

In addition to SCR analysis, average skin conductance levels (SCL) were also determined to provide a more comprehensive assessment of the EDA complex. The SCL component is a slower-acting, continuous fluctuation of general background arousal (tonic) and therefore provides information on the background autonomic tone of an individual's EDA profile (Boucsein, 2012; Dawson et al., 2007). Here, the signal during the showing of the main video clip (after the 5s set-up shot –described below) was divided into three equal epochs (of 10secs duration), and the SCL was defined as the minimum value of the signal that occurred during each epoch for each clip presentation. By definition, minimum SCL values occur outside of SCRs in the signal and are thus unrelated to faster-acting phasic SCRs. This means that they are not contaminated with higher activation levels resulting from SCR activity. In line with published recommendations, SCL values were square-root transformed before formal analyses (Braithwaite et al., 2014; Bush, et al., 1993; Dawson, et al., 2007), and pooled by category (POV, EXO and Baseline).

1.2.3 The Body-Threat Assessment Battery (BTAB)

All clips were filmed in high-definition on a Sony NEX FS 100 camera set to 25fps (frames-per-second). Clips were edited on FCP 7 in Pro Rez HD and exported via Quicktime with settings, MOV, 1920 x 1080, H264[3]. The BTAB contains a collection of 17 dynamic movie clips. Of these, 12 clips depict simulated aversive body-related "threatening" actions (body-threats) performed on a real body / avatar (see Figure 1; Appendix A). Examples include; a fingernail being removed with pliers, a cut to the throat, and the forearm being

[3] We thank the ArkMedia production company for all filming and post-production work on these stimuli.

slashed with a Stanley knife. The body-threat movie clips contain a perspective manipulation where the same "threat" was observed from two different perspectives. Half of the body-threat clips were presented from a perspective congruent to the observer's own body, i.e. a point-of-view perspective (POV), as if one was watching their own body being threatened. The other half were presented from an exocentric (EXO) perspective (the POV rotated 180° around the y-axis), as if one was directly observing another individual (Figure 1; Appendix A).

The remaining five clips were standardised *Baseline* stimuli depicting non-threatening behaviours applied to inanimate objects and fruit (a Stanley knife cutting a Banana, Pear, or rolling pin) or positive actions to the body (a soft brush stroking the forearm). The Baseline clips did not include a perspective manipulation, however there was a POV and EXO perspective version of the soft brush directed on the forearm to represent a positive action to a physical body.

Figure 1. Example screenshots from the body-threat clips . *Top left*: the fingernail being removed with pliers (EXO Fingernail). *Top right*: a syringe / injection procedure (POV Syringe). *Middle left*: slashing of the throat with a Stanley knife (EXO Neck). *Middle right*: cutting the wrist with a piece of glass (EXO Glass). *Bottom left*: cutting open the forearm with a Stanley knife (POV Stanley arm). *Bottom right*: removal of the little finger using pliers (EXO Cutting finger). Note each of the body-threats were presented from both a POV and EXO perspective.

The BTAB stimuli were presented using E-prime (v2.2) software, where the context and background were standardised across all clips using green-screen technology. A black background was added to each clip in post-production to avoid distraction or discrepancies that would capture attention. The framing of each clip focused on the upper torso of the body, ceasing at the model's upper neck so as not to convey any face-based emotional cues to the observing participant. All movie clips started with a 5 s "set-up" shot (which was a dynamic clip though contained little movement from the model / avatar) before the main clip began. The set-up shot was presented with a ramped luminance onset (500ms). The reason for this was twofold. First, it reduced the likelihood of eliciting any unwanted reaction by the sudden onset of a stimulus being presented on screen (i.e. a startle response). Second, it was used to cue the perspective that the movie clip was presented from. For the body-threat behaviour stimuli (i.e. POV or EXO), the set-up shots consisted of the upper torso of the body facing either away from the camera / observer (indicating a POV threat) or toward the camera / observer (indicating an EXO threat). The set-up shots for the Baseline, body-related brushing clips had the same POV and EXO set-up shot distinction, while the remaining Baseline clips (i.e. object / fruit) simply depicted an image of the relevant item.

Each clip was presented in a single trial lasting 35 s and in a randomised order across participants (Figure 2). Due to the content of the dynamic stimuli and the diverse actions being carried out, the imagery in the clips varied slightly in duration in which the threat stimuli were visible (see Table 1), however a black screen was added to the end of each clip to ensure that all stimulus presentations lasted 35 s in total. After each clip was presented, participants were required to answer a series of questions using rating scales (see 1.2.4). This was followed by a 5 s inter-trial interval (ITI) of a black screen to prepare the participant for the presentation of the next clip (and so on).

Table 1. A list of all movie clip stimuli with total presentation duration (note Threat Time includes the 5 s body-based set-up shot).

ID	**Group**	**Label**	**Threat Time (s)**	**Total time (s)**
1	Threat	POV Cutting finger	31	35
2	Threat	POV Fingernail	18	35
3	Threat	POV Glass	20	35
4	Threat	POV Neck	21	35
5	Threat	POV Stanley arm	22	35
6	Threat	POV Syringe	32	35
7	Threat	EXO Cutting finger	33	35
8	Threat	EXO Fingernail	19	35
9	Threat	EXO Glass	20	35
10	Threat	EXO Neck	23	35
11	Threat	EXO Stanley arm	23	35

12	Threat	EXO Syringe	32	35
13	Baseline	Paintbrush POV	28	35
14	Baseline	Paintbrush EXO	23	35
15	Baseline	Banana	16	35
16	Baseline	Pear	12	35
17	Baseline	Rolling pin	20	35

1.2.4 BTAB Questionnaire ratings

Participants were asked to provide psychological ratings at the end of viewing each clip. This consisted of three questions; "*How would you rate the emotional valence of the stimuli?*" (Valence), "*How would you rate the level of arousal of the stimuli?*" (Arousal) and "*Did you experience any sense of pain while viewing the stimuli?*" (Pain). The Valence question required participants to categorise each movie clip as either more pleasant (positive score) or more aversive (negative score) and was presented on a 11-point Likert scale ranging from -5 (*Extremely negative*) to +5 (*Extremely positive*). Negative scores for this question indicate the success of BTAB's body-threat stimuli in eliciting an aversive response. The Arousal question referred to the level of arousal during the presentation of the clips and was presented on a 9-point Likert scale ranging from 1 (*Extremely low*) to 9 (*Extremely high*). Finally, the Pain question was designed to measure if the participant experienced any perceived / illusory pain sensations while observing the clips, and this was also presented on a 9-point Likert scale and ranged from 1 (*Definitely not)* to 9 (*Definitely yes*). For both the Arousal and Pain questions, positive scores indicate the effectiveness of BTAB's body-threat stimuli in eliciting an affective response.

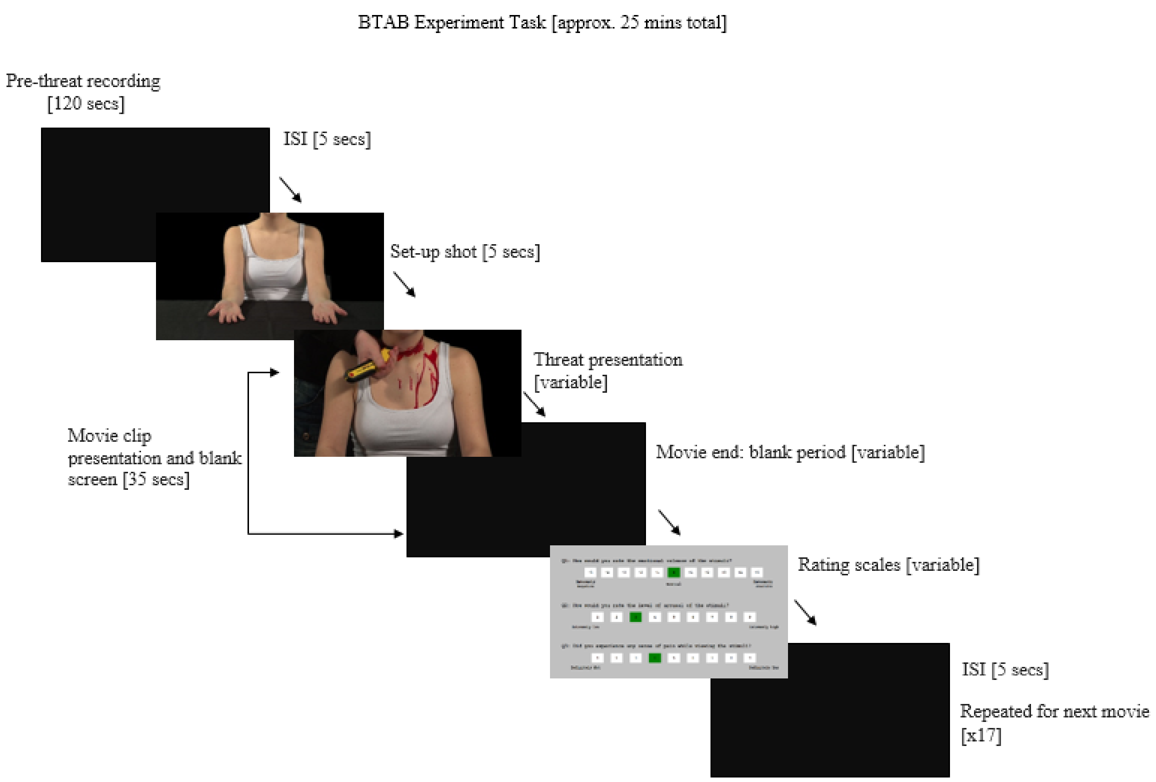


Figure 2. A timeline of the BTAB experimental stages which began with an inter-trial interval (ITI) of a blank screen followed by the presentation of a movie clip. After the clip presentation, participants provided ratings on the computer screen via the three scales (valence, arousal and pain).

1.2.5 Procedure

The BTAB task and questionnaire measures were completed in a single session lasting approximately 45 min. First, the experimenter provided verbal instructions, a consent form and information pack regarding the details of the study. The pack ensured participants were aware of the nature of the experiment and provided a set of statements of hypothetical situations that might typically generate unease or emotional distress e.g. *"I prefer not to watch an injection or blood giving procedure on my own body*". Participants were advised to re-consider participation if they answered yes to one or more of the statements and to consider all potential risks before agreeing to take part via a selection of consent statements.

Contingent on consent, participants progressed on to complete the BTAB. The electrodes for the EDA measure were attached to the individual for approximately 10 min before the BTAB was presented to ensure that the sensors had acclimatized before data collection. Participants were then instructed to simply stare at a blank computer screen for a pre-threat baseline period (150 s) while physiological measures were recorded. After this period, participants completed the BTAB task as described in 1.2.3 (Figure 2). The presentation order of each movie clip was randomised for each participant, and the BTAB experiment itself lasted approximately 25 min.

1.3 Results

Based on previous published observations (Boucsein, 2012; Dewe et al., 2016; 2018; Braithwaite et al., 2013; 2017; Dawson et al., 2007), 20 participants (10%) were removed from the sample as they were considered autonomic non-responders. Non-responders were quantified as those individuals who produced fewer than two SCRs per minute during the entire experiment. The final sample for analysis consisted of 180 participants, of which, 145 were female (81%) aged between 18 – 49 years ($\bar{X}$ = 21 years, SD = 5.62). All analyses and results presented here were based on transformed SCL values and SCRs that had been normalised / standardised as detailed in section 1.2.2 (Boucsein, 2012; Boucsein et al., 2012; Bush, et al., 1993; Dawson et al., 2007). Non-parametric tests were used for non-normally distributed data and corrected values (Greenhouse-Geisser) were taken when sphericity could not be assumed. We report effect sizes as Cohen's *d* (Cohen 1962, 1992), Pearson's *r* and partial eta squared (η^2_P). For multiple comparisons, the data were corrected using the False Discovery Rate (FDR: Benjamini, 2010; Benjamini & Hochberg, 1995), which is considered a powerful approach for more than three comparisons. The FDR is calculated using the formula $\alpha = (i/k)*Q$, where i = the original p-value ranked in ascending order, k = number of comparisons, and Q = the 0.05 significance threshold value. If $p < \alpha$ then comparisons are considered significant (Benjamini, 2010; Benjamini & Hochberg, 1995). The original p-values (p) together with the associated B&H critical values (α) are both reported.

Along with frequentist analysis, a Bayes Factor analysis was conducted using JASP software and the recommended default prior values (version 0.8.5.1: JASP Team, 2017; see Wagenmakers et al., 2017). Bayes probabilities are presented here as $BF_{10,}$ which indicate the probability of the alternative hypothesis in contrast to the null hypothesis ($BF_{10} > 1.0$), or the probability of the null hypothesis over the alternative ($BF_{10} < 1.0$). Typically, BF_{10} values that occur between 3 –10 are considered good to substantial evidence in favour of the alternative hypothesis, 10 – 100 is strong to very strong and > 100 is considered decisive. In contrast, values close to 0 for example, between 0.33 – 0.10 are considered substantial evidence, and 0.10 – 0.01 are considered strong to very strong evidence for the null hypothesis. Values around 1 (0.33 – 3) are considered anecdotal (Jarosz & Wiley, 2014; Kass & Raftery, 1995; Raftery, 1995; see also Marsman & Wagenmakers, 2016; Rouder, Speckman, Sun, Morey, & Iverson, 2009).

1.3.1 BTAB efficacy: SCR frequency

All movie clips were first assessed individually to determine their ability to elicit an autonomic response (SCR). For each clip presentation, a score of 1 was given if it generated at least one SCR within the designated 35 s epoch window (a score of 0 was given if it failed to generate a response). Thus, each movie clip could have a maximum response rate of 180 (i.e. the total number of participants). Response rates (percentages) for each clip are presented in Table 2 and reveal that the body-threat POV and EXO movie clips successfully generated a threat-SCR between 70 – 84% of the time compared to the non-threat Baseline clips (48 – 68%). Also presented in Table 2 is the average SCR / EDA information for each individual movie clip including the SCL values, the raw magnitude values (μS) of the threat-SCRs and the transformed threat-SCRs (see Appendix A for a summary of all normative data for each BTAB clip).

Table 2. Average EDA / SCR measurements for each movie clip stimuli including the response rate (%), raw SCL values from the three time periods, and raw (μS) and corrected (Z-score) threat-SCR values.

Movie Clip	**Response rate (%)**	**SCL Raw (μS) Time 1**	**SCL Raw (μS) Time 2**	**SCL Raw (μS) Time 3**	**Threat-SCR Raw (μS)**	**Threat-SCR Z-score**
POV Cutting finger	82%	13.31	13.57	13.36	1.60	0.39
POV Fingernail	80%	13.30	13.41	13.20	1.53	0.29
POV Glass	73%	13.21	13.07	12.93	1.11	-0.02
POV Neck	80%	13.37	13.35	13.16	1.56	0.33
POV Stanley arm	79%	13.33	13.40	13.19	1.58	0.36
POV Syringe	77%	13.27	13.35	13.12	1.40	0.26

EXO Cutting finger	78%	13.43	13.44	13.23	1.41	0.22
EXO Fingernail	81%	13.44	13.62	13.33	1.56	0.35
EXO Glass	81%	13.27	13.10	13.06	1.28	0.11
EXO Neck	70%	13.30	13.25	13.12	1.29	0.06
EXO Stanley arm	81%	13.41	13.44	13.25	1.58	0.39
EXO Syringe	84%	13.40	13.44	13.22	1.56	0.38
Baseline Paintbrush POV	52%	13.20	13.04	13.01	0.73	-0.49
Baseline Paintbrush EXO	59%	13.25	13.04	12.91	0.68	-0.50
Baseline Banana	48%	13.01	12.88	12.82	0.54	-0.69
Baseline Pear	57%	13.16	12.99	12.90	0.62	-0.55
Baseline Rolling pin	68%	13.11	13.06	12.98	0.94	-0.20

Note: *Response rate*: the count (percentage) of total responses of whether a clip elicited a threat-SCR. *SCL*: skin conductance level values (raw μS) at the time of the threat-SCR presentation. *Threat-SCR Raw (μS)*: the raw magnitude threat-SCR response. *Threat-SCR Z-score*: transformed threat-SCR values after being normalised (Log[+1]) and standardised (Z-score).

1.3.2 Individual clip analysis

Each individual clip was compared to the remaining clips from its respective pooled category (i.e. POV, EXO and Baseline) in relation to their efficacy (response rate) and strength (SCR magnitude) in generating a threat-SCR response. For the POV clips, a non-parametric Friedman's test with clip type (Cutting finger, Fingernail, Glass, Neck, Stanley arm, Syringe) as the only factor revealed no reliable effect for the efficacy of response rate, $X^2(5) = 6.25$, $p = .283$. All clips in this category were approximately equal in their ability to elicit a response. In terms of threat-SCR magnitudes, a Friedman's test (with clip type as the only factor) revealed a significant effect of the POV clips, $X^2(5) = 11.74$, $p < .05$. Wilcoxon signed-rank tests revealed that the POV Glass clip produced significantly lower threat-SCRs compared to all remaining POV clips (all *p*s < .05). The remaining POV clips were not significantly different from each other in terms of their threat-SCR magnitude (all *p*s > .213).

For the EXO clips, a Friedman's test with clip type (Cutting finger, Fingernail, Glass, Neck, Stanley arm, Syringe) as the only factor revealed a significant effect in their efficacy of eliciting a response, $X^2(5) = 15.38$, $p < .01$. Wilcoxon signed-rank tests revealed that the EXO Neck clip produced significantly fewer threat-SCRs compared to four EXO clips (Syringe, Glass, Stanley arm and Fingernail, all *p*s < .05). All remaining EXO clips were not significantly different to each other in their response rate (all *p*s > .048, corrected for multiple comparisons). For threat-SCR magnitudes, a Friedman's test (with clip type as the only factor) revealed a significant effect between the EXO clips, $X^2(5) = 18.20$, $p < .01$. Wilcoxon signed-rank tests revealed that the EXO Neck clip produced lower threat-SCR magnitudes compared to three EXO clips (Stanley arm, Syringe and Fingernail, all *p*s < .01), and the EXO Glass clip produced significantly lower threat-SCRs compared to two EXO clips (Stanley arm and Syringe; both *p*s < .05). All remaining EXO clips were not significantly different to each other in terms of their threat-SCR magnitudes (all *p*s > .032, when corrected for multiple comparisons).

For the Baseline clips, a Friedman's test (clip type: Paintbrush POV, Paintbrush EXO, Banana, Pear, Rolling pin) revealed a significant effect of response rate, $X^2(4) = 22.89$, $p < .001$. Wilcoxon signed-rank tests revealed that the Rolling pin produced significantly more responses compared to three Baseline clips (Banana, Paintbrush POV and Pear, all *p*s < .05). The Paintbrush EXO clip also produced more responses compared to the Banana clip ($p < .05$). None of the remaining Baseline clips were significantly different from each other (all *p*s > .038, corrected for multiple comparisons). In addition, a Friedman's test (with clip type as the only factor) revealed a significant effect of threat-SCR magnitudes between the Baseline clips, $X^2(4) = 30.29$, $p < .001$. Wilcoxon signed-rank tests revealed that the Rolling pin produced significantly larger threat-SCRs compared to all remaining Baseline clips (all *p*s < .01). The remaining Baseline clips were not significantly different from each other in terms of threat-SCR magnitudes (all *p*s > .040, corrected for multiple comparisons).

1.3.3 Categorical movie clip analysis

The clips were then pooled into their respective categories of POV, EXO and Baseline to analyse their ability to elicit an anxiety threat-SCR by category. As can be seen from Figure 3, the threat-related perspectives (both POV and EXO) generated more threat-SCRs compared to the Baseline clips, and this difference was significant using a non-parametric Friedman's test, $X^2(2) = 95.25$, $p < .001$. Wilcoxon signed-rank tests revealed that both the POV, Z = -8.06, $p < .001$, $r = 0.42$ and EXO perspectives, Z = -7.96, $p < .001$, $r = 0.42$ elicited significantly more threat-SCR responses compared to the Baseline clips. However, there was no significant difference in response rate between the POV and EXO perspectives, Z = -.31, $p = .756$, $r = 0.02$.

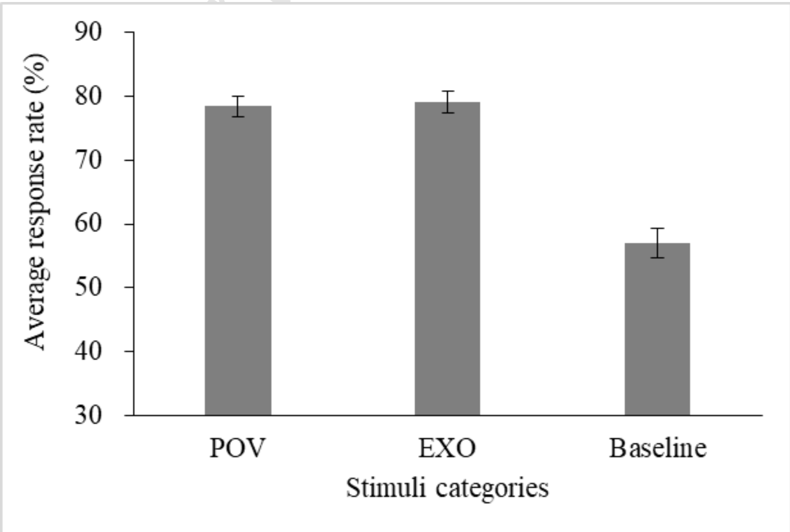


Figure 3. Average response rate (frequency, %) of threat-SCRs elicited during the three clip categories, POV, EXO and Baseline (error bars indicate ±1 SE).

1.3.4 Threat-SCR magnitudes

The average threat-SCR magnitudes were assessed in relation to the three categories, POV, EXO and Baseline (Figure 4). The average raw threat-SCR magnitudes were 1.46 μS for the POV clips, 1.45 μS for the EXO clips, and 0.70 μS for the Baseline clips. A one-way ANOVA on the transformed (Z-score) data revealed a significant effect of clip category, $F(1.88, 337.90) = 128.83$, $p < .001$, $\eta_p^2 = .419$. Pairwise comparisons revealed that both the POV, $t(179) = 13.02$, $p < .001$, $d = 0.97$, $BF_{10} > 1000$, and EXO clips $t(179) = 13.26$, $p < .001$, $d = 0.99$, $BF_{10} > 1000$, produced significantly larger threat-SCR magnitudes compared to the Baseline clips. However, there was no reliable difference of threat-SCR magnitudes between the POV and EXO perspectives, $t(179) = .32$, $p = .749$, $d = 0.02$, $BF_{10} = 0.09$.

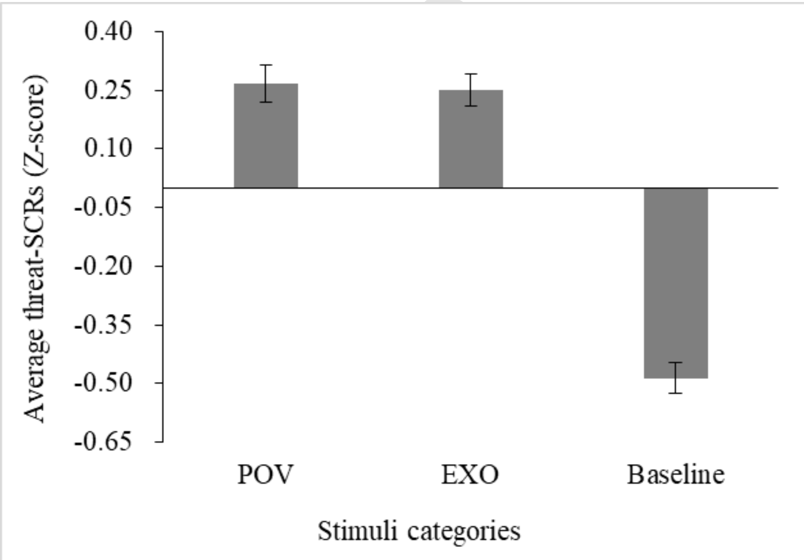


Figure 4. Average threat-SCR magnitudes (Z-score) for the three clip categories including POV, EXO and Baseline (error bars indicate ±1 SE).

1.3.5 SCL: Background arousal

Minimum SCL values over the three time epochs were calculated within the threat / baseline period (i.e. excluding the set-up shot) and were analysed across the three categories, POV, EXO and Baseline (Figure 5). A 3 (clip category: POV, EXO & Baseline) x 3 (SCL at time 1, 2, 3,) ANOVA revealed a significant effect of category, $F(1.86, 332.01) = 33.43$, $p < .001$, $\eta_P^2 = .157$, a significant effect of time, $F(1.41, 252.01) = 61.92$, $p < .001$, $\eta_P^2 = .257$, and an interaction of category x time, $F(2.45, 438.41) = 17.52$, $p < .001$, $\eta_P^2 = .089$. When exploring the effect of time, SCL values at times 1, 2 and 3 were all different from each other in all clip categories (all *t*'s > 2.08, all *p*'s < .039 corrected via the FDR procedure). The only exception was that SCL values at time 1 and time 2 were not significantly different for EXO clips ($t = .302$, $p = .763$). Next, we explored the effect of category using pairwise comparisons, which revealed that all categories were significantly different to each other at time 1 (all *t*'s > 2.21, all *p*'s < .029). Similarly, SCL during the Baseline clips was significantly different to SCL in both the POV and EXO clips at time 2 and time 3 (all *t*'s > 5.36, all *p*'s < .001). SCL values for the POV and EXO clips were not significantly different at time 2 or time 3 (all *t*'s < 1.24, all *p*'s > .218). This shows that the Baseline SCL was significantly lower (and declined from time 1 to time 3) compared to both body-threat categories (POV and EXO), while the POV and EXO clips, had similar patterns, remaining stable (or inclined) between times 1 and 2, before declining in time 3.

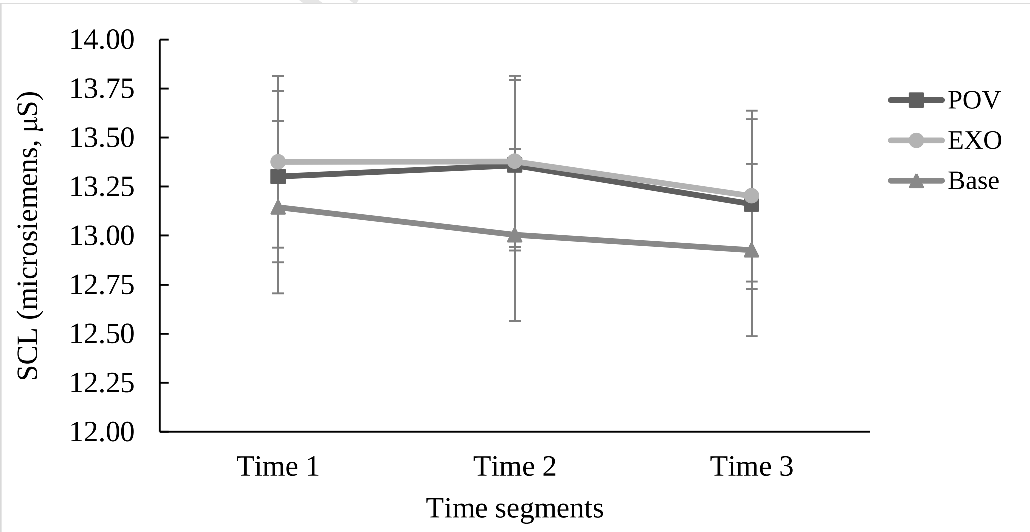


Figure 5. Minimum SCL values (raw μS, non-transformed) at the three, time periods for each movie category, POV, EXO and Baseline (error bars indicate ±1 SE).

1.3.6 SS-SCRs - frequencies

The frequency of SS-SCRs during each clip presentation (i.e. all remaining SCRs not identified as the largest threat-SCR that occurred during the clip presentation) were pooled into average frequencies for each category and divided by the combined clip length of each category (count per min [cpm]; Figure 6). A Friedman's test revealed a significant effect of category for SS-SCRs frequencies, $\chi 2$ (2) = 26.23, $p < .001$. Wilcoxon signed-rank tests revealed that the frequency of SS-SCRs was significantly higher during both the POV, Z = -4.83, $p < .001$, $r = 0.25$, and EXO clips Z = -3.69, $p < .001$, $r = 0.19$ compared to the Baseline clips. There was no significant difference in SS-SCR frequencies during the POV and EXO categories, Z = -1.00, $p = .320$, $r = 0.05$.

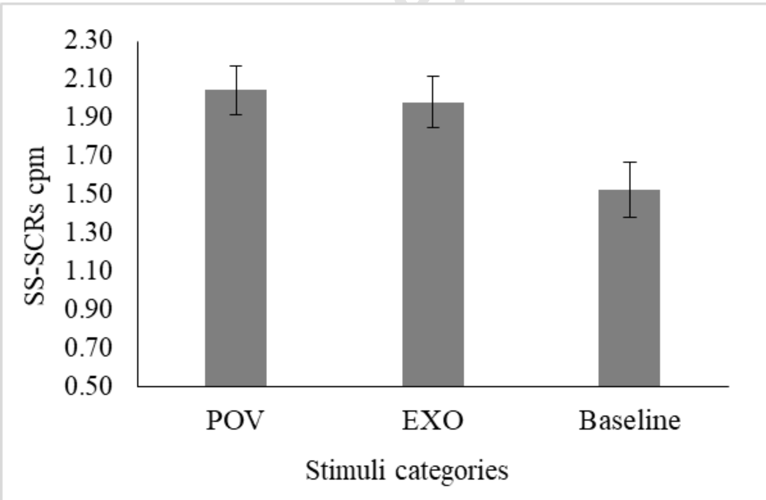


Figure 6. Average frequencies of SS-SCRs (cpm) during the POV, EXO and Baseline categories (error bars indicate ±1 SE).

1.3.7 SS-SCRs - magnitudes

Average SS-SCR magnitudes (Z-score) were analysed in each of the three clip categories (POV, EXO and Baseline) and are presented in Figure 7. Despite there being a significant difference in SS-SCR frequencies between both the POV and EXO clips relative to the Baseline clips, there was no significant difference in SS-SCR magnitudes across the categories when analysed via a one way ANOVA, $F(2, 358) = 1.02$, $p = .361$, $\eta_p^2 = .006$.4

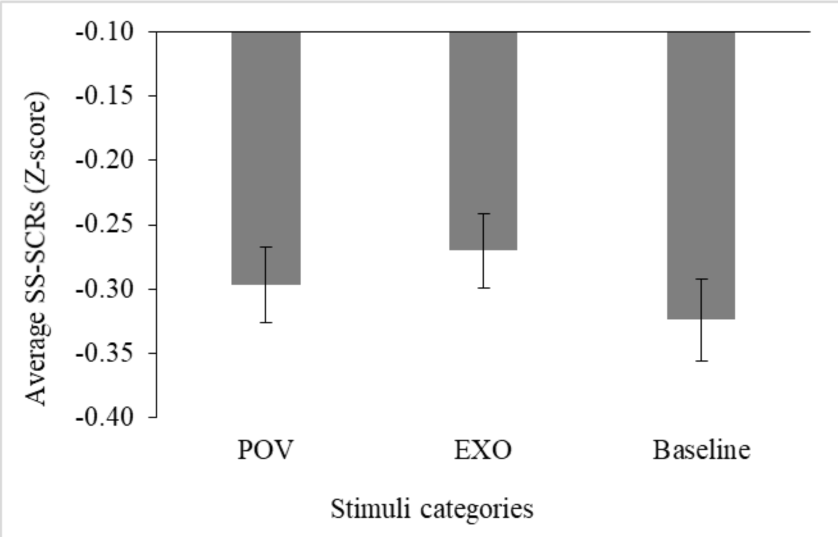


Figure 7. Average SS-SCR magnitudes (Z-score) for the POV, EXO and Baseline clips (error bars indicate ±1 SE).

1.3.8 BTAB psychological ratings

1.3.8.1 Valence ratings

The valence ratings for each clip category are shown in Figure 8 where negative values indicate an unpleasant / aversive response. A significant effect of valence was observed across the categories using a one-way ANOVA, $F(1.11, 199.06) = 829.12$, $p < .001$, $\eta_p^2 = .822$. Pairwise comparisons revealed that both the POV, $t(179) = 30.21$, $p < .001$, $d = 2.25$, $BF_{10} > 1000$ and EXO clips, $t(179) = 28.56$, $p < .001$, $d = 2.13$, $BF_{10} > 1000$ were associated with a negative (aversive) rating compared to the Baseline clips (which received a positive rating). Valence ratings for the POV and EXO stimuli however, did not significantly differ, $t(179) = .341$, $p = .733$, $d = 0.03$, $BF_{10} > 0.09$.

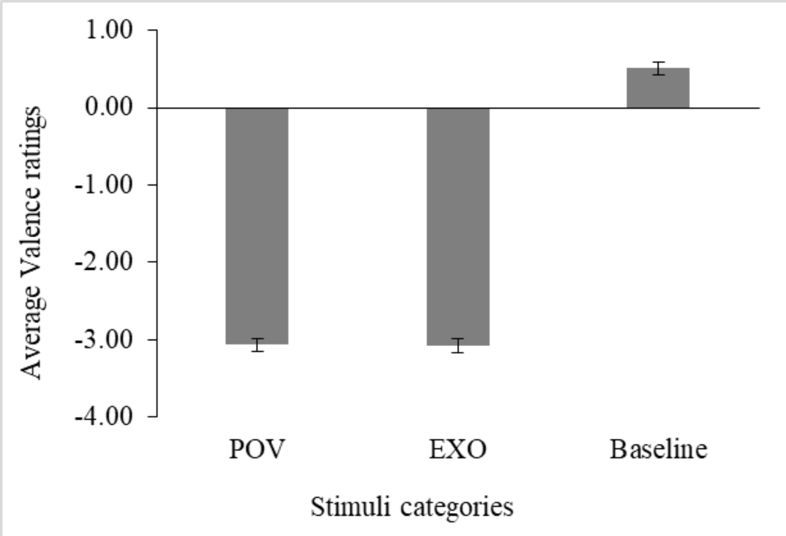


Figure 8. Average valence questionnaire ratings (possible range of responses -5 to +5) during the BTAB task for the POV, EXO and Baseline clips (error bars indicate ±1 SE).

1.3.8.2 Arousal ratings

Average Arousal ratings were compared for the three categories, where positive scores indicated greater emotional arousal (i.e. the stimuli were effective at eliciting at emotional response) and negative scores reflected a lack of emotional arousal (Figure 9). A one-way ANOVA revealed a significant effect of category, $F(1.13, 202.58) = 328.20$, $p < .001$, $\eta_p^2 = .647$. Pairwise comparisons revealed a higher level of reported emotional arousal for both the POV, $t(179) = 18.39$, $p < .001$, $d = 1.37$, $BF_{10} > 1000$ and EXO clips, $t(179) = 18.62$, $p < .001$, $d = 1.39$, $BF_{10} > 1000$ compared to the Baseline clips. Arousal ratings for the POV and EXO clips did not differ reliably, $t(179) = .708$, $p = .480$, $d = 0.05$, $BF_{10} > 0.11$.

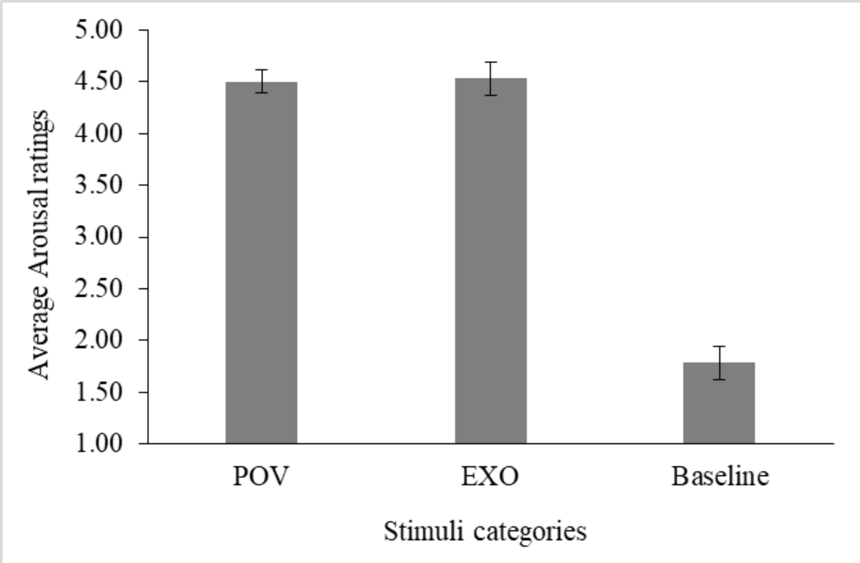


Figure 9. Average Arousal scores from the BTAB experiment rating scale (possible range of responses 1 to 9) for the POV, EXO and Baseline clips (error bars indicate ±1 SE).

1.3.8.3 Pain ratings

The Pain scale measured the pain or physical sensation perceived while participants observed each clip. A positive score indicated agreement to the presence of such sensation, while a negative score indicated the opposite (Figure 10). A significant effect of average pain rating was observed across the clip categories via a one-way ANOVA, $F(1.17, 210.07) = 142.25$, $p < .001$, $\eta_P^2 = .443$. Pairwise comparisons revealed significantly increased perceived pain ratings for both the POV, $t(179) = 12.10$, $p < .001$, $d = 0.90$, $BF_{10} > 1000$, and EXO, $t(179) = 12.44$, $p < .001$, $d = 0.93$, $BF_{10} > 1000$, clips compared to the Baseline ratings. There was no reliable difference between the average pain ratings for the POV and EXO clips, $t(179) = .084$, $p = .933$, $d = 0.01$, $BF_{10} > 0.08$.

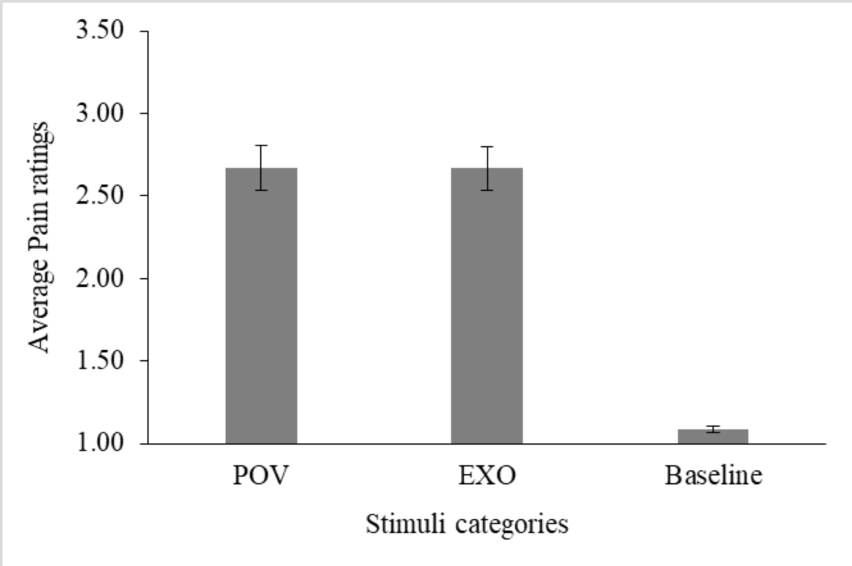


Figure 10. Average Pain scores from the BTAB task rating scale (possible range of responses 1 to 9) for the POV, EXO and Baseline clips (error bars indicate ±1 SE).

Given that the two clip perspectives POV and EXO did not significantly differ in terms of their efficacy (or magnitude) in eliciting a threat-SCR, the frequency and magnitude of SS-SCRs, the associated background arousal (SCL) or their psychological ratings, both perspectives were pooled and are henceforth referred to as "*Body-threat*" stimuli (which will be compared against the "Baseline", non-body threat clips). Overall, this new body-threat category elicited a response 79% of the time and revealed an average threat-SCR magnitude of 1.46 μS (0.26 Z-score).

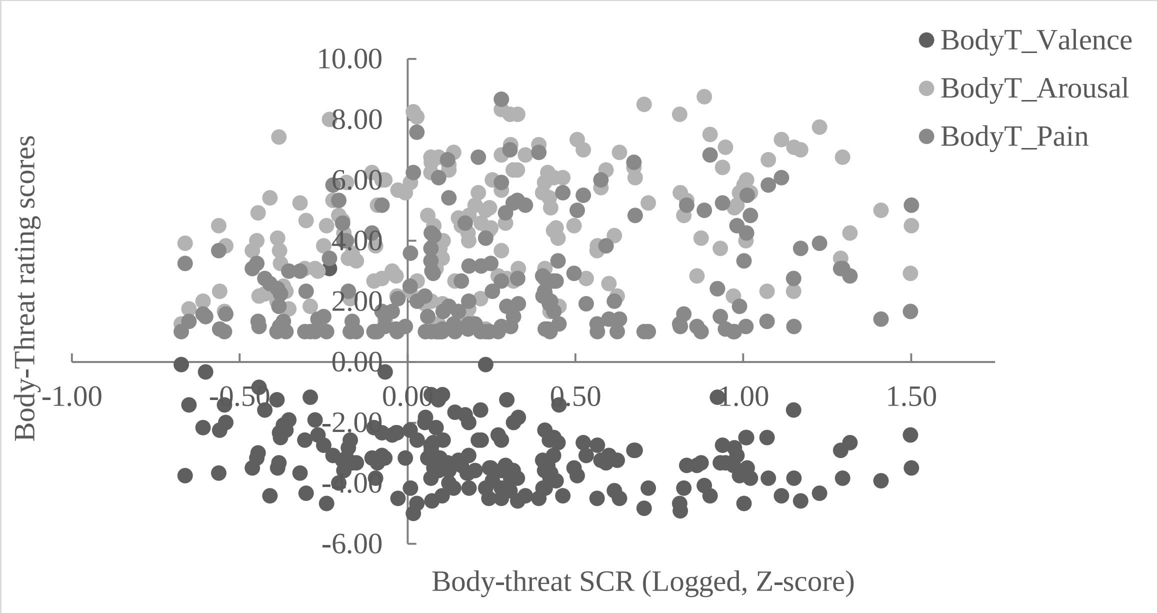
1.3.9 Autonomic measures and psychological ratings

The correlations between the average threat-SCR magnitudes (Z-score) for the Body-threat and Baseline clips and rating scores (valence, arousal and pain) were calculated (Table 3; and Figure 11). There was a significant negative correlation between average valence ratings and Body-threat SCRs, suggesting that as these clips were rated more negatively, the strength of the threat-SCRs increased. A significant positive correlation was observed between Body-threat SCRs and arousal ratings, indicating that the higher the ratings of autonomic arousal, the greater the threat-SCRs. Average pain rating scores also significantly correlated with the Body-threat SCRs, suggesting that the higher the threat-SCRs, the higher the ratings of a perceived pain sensation. In addition, none of the rating scales (valence, arousal and pain) correlated with threat-SCRs from the Baseline clips.

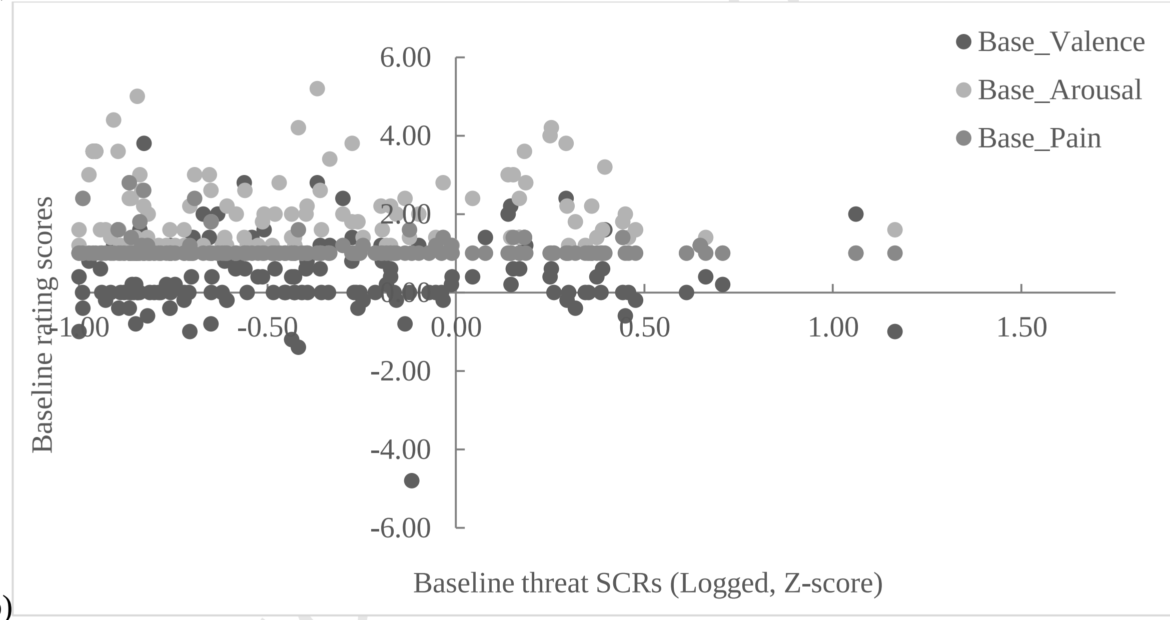
Table 3. Pearson correlation coefficients for corrected significance values and Bayes factor analysis of average Body-threat and Baseline clip SCRs with questionnaire ratings (valence, arousal and pain).

	Frequentist					Bayes	
	r	**P-value**	**Rank**	**B&H value**	**Sig**	**BF_{10}**	**Interpretation**
Body-threat SCR x Arousal	0.32	0.000	1	0.008	sig*	942.74	Decisive Alt
Body-threat SCR x Valence	-0.31	0.000	2	0.017	sig*	648.69	Decisive Alt
Body-threat SCR x Pain	0.18	0.016	3	0.025	sig*	1.66	Anecdotal Alt
Baseline SCR x Valence	-0.12	0.113	4	0.033	ns	0.32	Anecdotal Null
Baseline SCR x Pain	-0.11	0.157	5	0.042	ns	0.25	Substantial Null
Baseline SCR x Arousal	-0.01	0.861	6	0.050	ns	0.10	Strong Null

Note: Sig* = significant correlations after using the FDR procedure (Benjamini & Hochberg, 1995) for multiple comparisons (ns = non-significant). In line with recommended guidelines (Jarosz & Wiley, 2014; Jeffreys, 1961), Bayes factors ($BF_{10)}$ and their interpretations are reported (Alt = Alternative hypothesis and Null = Null hypothesis).



a)



b)

Figure 11. *Top* (a) Body-threat SCRs (logged, Z-scored) correlated with Body-Threat (BodyT) ratings on Valence, Arousal and Pain. *Bottom* (b) Baseline threat-SCRs (logged, Z-scored) correlated with Baseline (Base) Valence, Arousal and Pain ratings.

1.3.10 Baseline corrected analysis

To determine the extent to which responses were tied more to body threat-related factors rather than just merely being aversive, average threat-SCR magnitudes (Z-score) for the Baseline clips were subtracted from the threat-SCR magnitudes for the Body-threat clips to create a difference (delta) value. This procedure was also performed on psychological ratings; where average ratings for the Baseline clips were subtracted from average Body-threat ratings (for valence, arousal and pain). The correlations between these resultant delta values are shown in Table 4. There was a significant negative correlation between valence ratings and the SCR delta, which suggests that as the difference between Body-threat and Baseline SCRs increased (i.e. the Body-threat elicited larger threat-SCRs relative to the Baseline), there was a greater difference in the categorisation type (i.e. a negative valence for Body-threat clips and a positive valence for Baseline clips). In addition, significant positive correlations were observed for both the arousal and pain ratings with average SCR deltas[4]. This suggests that as the SCR delta increased between the Body-threat and Baseline clips (i.e. larger SCRs for the Body-threats), the greater the difference in arousal and pain ratings; where Body-threat clips were associated with greater endorsement of autonomic / affective arousal and perceived pain).

[4] Note – although there were no reliable difference in the magnitude of SS-SCRs for the Body-threat vs Baseline stimuli, we also repeated this baseline corrected analysis for the SS-SCRs. None of the correlations were significant (all $r < .08$, all *p*s > .311).

Table 4. Pearson correlation coefficients for corrected significance values and Bayes factor analysis of average SCR delta values between Body-threat and Baseline clips and corrected questionnaire ratings (valence, arousal and pain).

	Frequentist					Bayes	
	r	**P-value**	**Rank**	**B&H value**	**Sig**	**BF_{10}**	**Interpretation**
SCR delta x Arousal	0.39	0.000	1	0.017	sig*	> 1000	Decisive Alt
SCR delta x Pain	0.26	0.001	2	0.033	sig*	37.71	Strong Alt
SCR delta x Valence	-0.24	0.001	3	0.050	sig*	18.98	Strong Alt

Note: Sig* = significant correlations after using the FDR procedure for multiple comparisons (Benjamini & Hochberg, 1995). In line with recommended guidelines (Jarosz & Wiley, 2014; Jeffreys, 1961) we report Bayes factors ($BF_{10)}$ and their interpretations (Alt = Alternative hypothesis).

1.4 General Discussion

The present study examined the utility of a new assessment battery (the BTAB) for the investigation of psychological and autonomic psychophysiological responses towards negative body-threat stimuli. In contrast to other affective imagery sets, the BTAB consists of high-definition dynamic clips portraying a host of body-threat scenarios, with matched, non-body threat baseline imagery, standardised by green-screen technology and a perspective manipulation. Normative data (for the threat and baseline categories) for both psychological and psychophysiological responses have been presented and the measure explored formally.

1.4.1 Autonomic Responses

Body-threat clips induced an autonomic response 79% of the time, suggesting that they were highly effective at eliciting aversive autonomic reactions (the Baseline clips induced responses in 57% of cases). This observation reinforces the assumption that the arithmetic averages calculated are supported by a reliable number of data points. As noted in 1.1, the computed averages from previous studies have not always reported the efficacy of stimuli at eliciting SCRs and therefore could potentially be based on only a handful of responses – leading to questions over their efficacy as a reliable and stable arithmetic average (Armel & Ramachandran, 2003; Cuthbert et al., 2003; Drabant et al., 2011; Giesbrecht et al., 2010; Lemche et al., 2008).

The average magnitude for the Body-threat clips was 1.46 μS (0.26, Z-score) in comparison to 0.70 μS (-0.49, Z-score) for the Baseline clips. Consequently, body-threats induced significantly more responses, and of higher magnitude, relative to baseline stimuli, providing evidence of a reliable increase in autonomic responding significantly above that of the non-body threat baseline stimuli. For threat-SCR amplitudes, one might be concerned that the approach of selecting the largest SCR among a selection of clips that have variable durations could lead to a higher probability of detecting a large SCR that was generated by chance alone for longer video clips (i.e. for the body-threat clips compared to the baseline clips, which were shorter). However, against this, in further analysis, we note that the largest response was, in fact, also the 1st response in approximately 80% of all clips. In fact, there were no reliable differences between clip categories; the largest SCR was the 1st SCR 82% of times for POV clips, and in 80% of cases for both the EXO and Baseline clips. The size of the first SCR within a clip should not be influenced by the length of the clip. Thus, the observed difference in SCR size between body-threat and baseline clips cannot be accounted for simply by their being a greater probability of large SCRs being generated (and hence detected) by chance alone in the longer clips. In addition, the average latency (in seconds) for the largest threat-SCRs in each category was indeed very similar; 5 secs for both the POV and EXO clips and 4 secs for the Baseline clips. Hence, the largest threat-SCR occurred at a similar time point after stimuli onset, irrespective of overall clip length.

There were no reliable effects of perspective (POV vs EXO) on any of the autonomic measures. That is, the frequency of threat-SCRs, their strength, the amplitudes of the SCL, and the characteristics of the SS-SCRs (i.e. both frequency and strength of SS-SCRs) were equivalent across POV and EXO perspectives. Based on findings suggesting that observers can automatically adopt an egocentric (first person: POV) perspective when viewing stimuli / avatars, and evidence of shared activation or increased autonomic arousal when observing another individual being threatened (Samson et al., 2010; Dewe et al., 2018; Jackson et al., 2005; Jackson, Brunet et al., 2006; Jackson, Rainville et al., 2006) we originally hypothesised that threats delivered from an egocentric point-of-view (POV) might elicit larger autonomic responses and stronger psychological ratings compared to threats perceived from an exocentric (EXO) perspective. Clearly, this was not the case. Although we should be cautious of interpreting a null finding (even with a Bayes analysis which we present here) this may have occurred because observers were not actively required to use the perspective in any particular way (akin to a perspective-taking task), nor were they actually seated in the same room physically opposite or seated next to the actress / avatar (e.g. as in Dewe et al., 2018). Observers were merely instructed to passively observe the stimuli on screen. It appears then that autonomic responding from passively viewing dynamic stimuli is not reliably mediated by perspective mechanisms – at least as far as the current BTAB measure was designed and implemented. Further research could examine this matter in more detail.

The autonomic measures of SCL, threat-SCR frequency and threat-SCR magnitude were always significantly higher for the Body-threat clips relative to the Baseline clips.

Likewise, there was an increase in SS-SCR frequency for the Body-threat clips relative to the Baseline clips, however no such difference was observed for the magnitude of SS-SCR. This is noteworthy as previous research has shown that an increase in the frequency of SCRs can be associated with negatively-tuned cognitive states (Nikula, 1991; see Boucsein, 2012). Consequently, the increase in frequency of SS-SCRs, but not an increase in the magnitude of them, could reflect a general background increase in autonomic processing associated with negative aversive imagery. The significant increase in the general background SCL during the viewing of the body-threat stimuli also supports the view that the threat imagery was potent enough to induce a generalised increase in autonomic arousal, perhaps reflecting the increased aversion experienced.

1.4.2 Psychological ratings

In line with the findings observed for the autonomic measures, psychological ratings of valence, arousal and pain were significantly different for the Body-threat clips relative to the Baseline clips. Body-threat clips induced significantly higher ratings of arousal and pain and received negative ratings of valence relative to the Baseline clips (which received a positive rating). In addition, in line with the findings for autonomic measures, none of the rating scales were mediated by perspective, i.e. whether the threat stimuli were presented from a POV or EXO viewpoint.

1.4.3 Interactions between psychophysiology and psychology

An important aspect of the BTAB is the use of baseline stimuli. The BTAB allows for the subtraction of baseline responses from the magnitude of the responses from the body-based aversive imagery. The underlying rationale here was to subtract the effects of viewing actions towards objects from viewing aversive actions / threats directed towards a physical body. Therefore, what is conceived of as a baseline here represents a category that shows no body-threat to anticipate or perceive – though a threatening stimulus (i.e., the knife) was indeed still depicted in most clips. This provides a conservative estimate of the subtraction of the body-threat component[5]. We assumed that this new "delta" would reflect the psychophysiological and psychological components related to the processing of body-related threats specifically. If so, then these threat-SCR delta values should be reliably associated with subtracted psychological ratings. This was exactly what we found.

Increased magnitudes in the threat-SCR delta values correlated significantly with ratings of increased arousal and pain. Furthermore, increased magnitudes in the threat-SCR delta values also correlated significantly with greater negativity on the valence dimension (i.e., a negative correlation). However, crucially, there were no significant correlations between any of the psychological ratings and autonomic arousal (SCRs) for the baseline clips. These findings support our contention that the autonomic psychophysiological reactivity measured here is indeed reflecting, at least in part, the cognitive and affective processing / appreciation of the aversive imagery depicted in the threat clips.

1.4.4 Potential utility of the BTAB

The BTAB contains its own standardised baseline stimuli, something not readily explored in previous research with other imagery measures. For example, studies discussed in 1.1 that used the IAPS (Sierra et al., 2002; 2006; Phillips et al., 2001) included neutral images with variable content such as an image of an animal (cow) and umbrella. In the BTAB, the baseline stimuli were designed to still contain some aversive elements (i.e., the presence /

[5] Note, the paintbrush clip does provide an action towards a body (albeit a positive one) and so to our mind is not the purest form of contrast in terms of examining actions towards a body.

image of a knife and cutting actions in some cases), but not ones that represent a threat or insult to the human body. By subtracting the responses for the Baseline stimuli from the Body-threat stimuli, a conservative estimate of the component that represents the processing of the actual body-threat can be estimated (at least to some degree).

One promising potential application for the BTAB would be to couple its use to modern neuroimaging and brain-stimulation methods such as Transcranial Magnetic Stimulation (TMS) and multi-channel transcranial direct-current stimulation (MtDCS). This could help to reveal; (i) the involvement of particular neural networks mediating the processing and representation of body information, (ii) when in time such processes appear to be important, and subsequently, (iii) aberrant biases in the mediation of such information that could be implicated in disorders of self-awareness and body representation (such as depersonalization disorder, somatoform disorders, out-of-body experiences, eating disorders, pain perception, and clinical conditions in general).

Recent research has demonstrated that the presentation of body-related visual stimuli elicits the strongest / favoured responses from “body-specific” attentional brain regions including the extrastriate body area (EBA), the fusiform body area (FBA) and to some extent the temporo-parietal junction ([TPJ]: Astafiev, Stanley, Shulman, & Corbetta, 2004; Berlucchi & Aglioti, 2010; David et al., 2007; Downing, Jiang, Shuman, & Kanwisher, 2001; Hodzic, Kaas, Muckli, Stirn, & Singer, 2009; see Peelen & Downing, 2005, 2007). For example, brain imaging methods have revealed that the EBA (an area of the lateral occipitotemporal cortex) displays a preferred response for images of human bodies and body parts – relative to faces and other control stimuli (Peelen & Downing, 2005, 2007; see Downing et al., 2001; Pinsk et al., 2009). Furthermore, evidence suggests that the EBA shows additional activation for exocentric relative to egocentric (POV) views of body parts and that it responds selectively to sensorimotor integration from one’s own goal-directed bodily movements. This implies some form of involvement in computing the self / non-self distinction and monitoring the sensory consequences of one's own actions (see; Astafiev et al., 2004; Berlucchi, & Aglioti, 2010; Downing et al., 2001; Peelen & Downing, 2005; 2007; Pinsk et al., 2009; Schwarzlose, Baker & Kanwisher, 2005; Taylor, Wiggett & Downing, 2007; Urgesi, Berlucchi & Aglioti, 2004). Determining the role of these body-networks and doing so in relation to aberrant processing associated with anomalous body experiences could be an important avenue for future research in the fields of body-processing, embodiment and self-consciousness.

The previous research that has explored autonomic responding in relation to depersonalization disorder (for example) has not explored the specific coupling between body-related / body-specific stimuli and the nature of the symptoms reported (Giesbrecht, et al., 2010; Sierra et al., 2002; 2006; Phillips et al., 2001). Uniting the use of the BTAB, with these topic areas and dovetailing the role of posterior body-attentional networks (discussed above) with more anterior networks mediating interoceptive awareness / predictive coding, i.e., the anterior insula cortex (AIC) and the ventrolateral pre-frontal cortex (vPFC) might prove fruitful.

1.4.5 Limitations and Future Directions

The present findings illuminate the psychophysiological and psychological data to establish the BTAB (via normative data to establish the stimuli and the categorical distinctions: threat vs baseline). The measure is clearly in its infancy and it is hoped that the battery will grow and expand with new scenarios and / or stimuli being added (in line with the development of similar systems like the IAPS), thus becoming a more comprehensive measure for body-threat specific imagery for broader scientific enquiry. For example, the measure could be developed by adding more baseline clips, which could include the addition of more positive body-action imagery (this could also become an interesting new category in its own right). Such additions would expand the gradation of categories from negative body-threats, through to positive body images (i.e., tickling, or stroking), through to additional non-body actions akin to the use of fruit and objects reported in the current measure.

Irrespective of future developments, the current battery provides a novel and timely resource for researchers to utilise for research, which has a more specific “body” and “aversion” focus. The data for the BTAB presented here can inform researchers as to the potency and usefulness of each individual clip or the category (threat vs baseline) as a whole.

1.5 Conclusion

The current study presented a novel instrument for the assessment of responses to threat-related imagery directed towards a human body – the Body-Threat Assessment Battery (BTAB). The BTAB consists of; (i) dynamic high-definition movie clips depicting body threats, (ii) non-body threat baseline behaviours, and (iii) a perspective manipulation for the body-threat clips. Green-screen technology was implemented so that extraneous background information could be removed and standardised in post-production. Normative data for psychological ratings (valence, arousal and pain) and psychophysiological responses (phasic skin conductance responses [SCRs] and tonic skin conductance levels [SCLs]) were presented. The findings are discussed in the context of the utility and scope of the BTAB for supporting neurocognitive investigations of aversive imagery and body-threats specifically.

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Appendix A: Psychological and psychophysiological normative data for BTAB stimuli

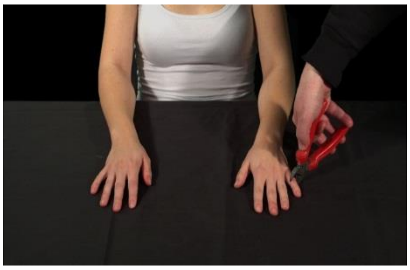
Body-Threat Stimuli: observed from a POV (point-of-view) perspective (N = 6)

		
Stimuli: **POV Cutting Finger**	Stimuli: **POV Fingernail**	Stimuli: **POV Glass**
Description: Little finger is ferociously cut and removed using a pair of pliers. Observed from a point-of-view perspective.	Description: Fingernail of the middle finger is pulled off using a pair of pliers. Observed from a point-of-view perspective.	Description: Lower wrist is sliced laterally using a piece of glass. Observed from a point-of-view perspective.
Valence: -3.64	Valence: -3.05	Valence: -2.62
Arousal: 5.13	Arousal: 4.60	Arousal: 3.76
Pain: 2.93	Pain: 2.87	Pain: 2.11
$\overline{X}$ SCR (μS): 1.60	$\overline{X}$ SCR (μS): 1.53	$\overline{X}$ SCR (μS): 1.11
SCR (Z-score, logged): 0.39	SCR (Z-score, logged): 0.29	SCR (Z-score, logged): -0.02

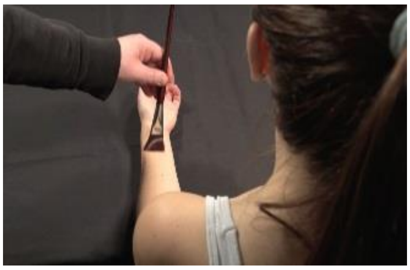
		

Stimuli: **POV Neck**	Stimuli: **POV Stanley Arm**	Stimuli: **POV Syringe**
Description: Neck is cut laterally across the throat using a Stanley knife. Observed from a point-of-view perspective.	Description: Forearm is sliced downwards with a Stanley knife to create an open, deep wound. Observed from a point-of-view perspective (avatar).	Description: Syringe is inserted into the lower wrist and 3cm (approx.) of blood is withdrawn. Observed from a point-of-view perspective.
Valence: -3.24	Valence: -3.61	Valence: -2.25
Arousal: 4.37	Arousal: 5.04	Arousal: 4.12
Pain: 2.57	Pain: 2.91	Pain: 2.64
$\overline{X}$ SCR (μS): 1.56	$\overline{X}$ SCR (μS): 1.58	$\overline{X}$ SCR (μS): 1.40
SCR (Z-score, logged): 0.33	SCR (Z-score, logged): 0.36	SCR (Z-score, logged): 0.26

Body-Threat Stimuli: observed from an EXO (exocentric, opposite) perspective (N = 6)

		
Stimuli: **EXO Cutting Finger**	Stimuli: **EXO Fingernail**	Stimuli: **EXO Glass**
Description: Little finger is ferociously cut and removed using a pair of pliers. Observed from an exocentric perspective.	Description: Fingernail of the middle finger is pulled off using a pair of pliers. Observed from an exocentric perspective.	Description: Lower wrist is sliced laterally using a piece of glass. Observed from an exocentric perspective.
Valence: -3.43	Valence: -3.09	Valence: -2.78
Arousal: 4.98	Arousal: 4.58	Arousal: 4.08
Pain: 2.83	Pain: 2.99	Pain: 2.33
$\overline{X}$ SCR (μS): 1.41	$\overline{X}$ SCR (μS): 1.56	$\overline{X}$ SCR (μS): 1.28
SCR (Z-score, logged): 0.22	SCR (Z-score, logged): 0.35	SCR (Z-score, logged): 0.11

		
Stimuli: **EXO Neck**	Stimuli: **EXO Stanley Arm**	Stimuli: **EXO Syringe**
Description: Neck is cut laterally across the throat using a Stanley knife. Observed from an	Description: Forearm is sliced downwards with a Stanley knife to create an open, deep wound.	Description: Syringe is inserted into the lower wrist and 3cm (approx.) of blood is withdrawn.

exocentric perspective.	Observed from an exocentric perspective (avatar).	Observed from an exocentric perspective.
		
Stimuli: **Baseline Brush POV**	Stimuli: **Baseline Brush EXO**	Stimuli: **Baseline Banana**
Description: Forearm is softly	Description: Forearm is softly	Description: Banana is sliced
Valence: -3.43	Valence: -3.53	Valence: -2.22
Arousal: 4.56	Arousal: 5.05	Arousal: 3.95
Pain: 2.52	Pain: 2.87	Pain: 2.47
$\overline{X}$ SCR (μS): 1.29	$\overline{X}$ SCR (μS): 1.58	$\overline{X}$ SCR (μS): 1.56
SCR (Z-score, logged): 0.06	SCR (Z-score, logged): 0.39	SCR (Z-score, logged): 0.38

Baseline Stimuli: Non-body threat behaviours to a body, object and fruit (N = 5)

stroked up and down with a soft brush. Observed from a point-of-view perspective.	stroked up and down with a soft brush. Observed from an exocentric perspective.	open in a downwards motion using a Stanley knife. No perspective manipulation – observed from an exocentric viewpoint.
Valence: 0.98	Valence: 1.04	Valence: 0.29
Arousal: 2.31	Arousal: 2.19	Arousal: 1.52
Pain: 1.11	Pain: 1.09	Pain: 1.06
$\overline{X}$ SCR (μS): 0.73	$\overline{X}$ SCR (μS): 0.68	$\overline{X}$ SCR (μS): 0.54
SCR (Z-score, logged): -0.49	SCR (Z-score, logged): -0.50	SCR (Z-score, logged): -0.69
		
Stimuli: **Baseline Pear**	Stimuli: **Baseline Rolling Pin**	
Description: Pear is sliced in an upwards direction using a Stanley knife. No perspective manipulation – observed from an exocentric viewpoint.	Description: Rolling pin is sliced in an upwards direction using a Stanley knife. No perspective manipulation – observed from an exocentric viewpoint.	
Valence: 0.18	Valence: 0.06	
Arousal: 1.55	Arousal: 1.35	
Pain: 1.13	Pain: 1.04	
$\overline{X}$ SCR (μS): 0.62	$\overline{X}$ SCR (μS): 0.94	
SCR (Z-score, logged): -0.55	SCR (Z-score, logged): -0.20	

Highlights

- A new instrument for examining threats directed on a human body is presented.
- Body-threats and non-body related baseline clips are provided.
- A perspective manipulation for body-threat stimuli was created.
- Normative large sample data for all dynamic clips are presented.
- Psychophysiological and Psychological data are presented for all stimuli.